Test Plan and Executive Summary for

IRGANOX 1035

(Revised)

Thiodiethylene bis (3,5-di-tert-butyl-4-hydroxyhydrocinnamate)

CAS No. 41484-35-9

Name of Sponsoring Organization: Ciba Specialty Chemicals Corporation
Technical Contact Persons: Richard Balcomb and Shailaja Rao
Address: 540 White Plains Road
Tarrytown, New York 10591 USA

Tel: (914) 785-2000
Fax: (914) 785-4147
DATE: JULY 12, 2007

EXECUTIVE SUMMARY

A. Introduction

An important objective of EPA's High Production Volume (HPV) chemical challenge program is the gathering and public release of basic hazard information on those chemicals manufactured at high volumes in the United States. Ciba Specialty Chemicals has agreed to participate in this program and hereby submit for review and public comment our available data and test plan for Irganox 1035.

B. General Substance Information

Chemical Name: Thiodiethylene bis (3,5-di-tert-butyl-4-hydroxyhydrocinnamate)

Appearance: White to off-white crystalline powder.

Typical Commercial Purity: >99%

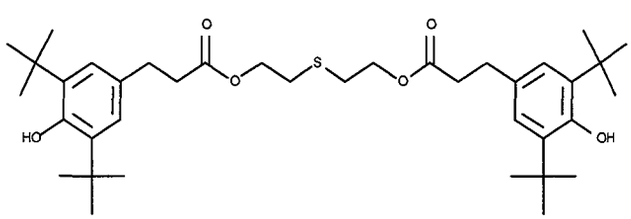
Chemical Abstract Service Registry Number: 41484-35-9

Trade Names: Irganox 1035 and Irganox L 115

Chemical Formula: $C_{38}H_{58}O_6S_1$

Molecular weight: 642.94

Structure:



C. General Use Information

Thiodiethylene bis (3,5-di-tert-butyl-4-hydroxyhydrocinnamate), commonly known as Irganox 1035, is a sterically hindered phenolic antioxidant. Irganox

1035 is a thermal stabilizer recommended for the stabilization of polyolefins, elastomers and other polymeric substances. Irganox 1035 is also an effective stabilizer for inhibiting oxidation, gel formation and discoloration of EPDM (ethylene propylene diene monomer), polybutadiene and emulsion SBR (styrene butadiene) organic substrates such as plastics, synthetic fibers, and elastomers. Irganox 1035 is widely used for stablization of polyethylene cable and wire resins. Under the tradename Irganox L 115, the compound is sold as an additive for synthetic and partially synthetic lubricants and for engine oils.

This product has been cleared by the FDA for use in polymers, resins or adhesives intended for food contact applications [21 CFR (Code of Federal Regulations) § 178.3570] at concentrations up to 0.5% of the article.

Environmental Endpoints

Existing ecotoxicology data for this chemical indicate that it has low toxicity to fish and aquatic plants. Testing has also shown it is moderately toxic to aquatic invertebrates. The solubility of the compound is very low[1] and residues that enter aquatic systems will likely become bound to sediment. The material is not readily biodegradable, however, environmental exposures are expected to be negligible and overall there is low concern for adverse ecological effects.

A hydrolysis study has not been conducted. The very low water solubility of the compound makes such testing impractical or impossible. The low water solubility of the material also makes it unlikely that hydrolysis would be a significant route of environmental degradation. No testing is proposed for this endpoint.

Toxicology Endpoints

Available mammalian acute toxicity data indicates the material is practically non-toxic by oral, dermal or inhalation exposure. The compound is also not mutagenic or clastogenic. Subchronic testing has shown the material is well tolerated over periods up to 90 days with no clinical effects or mortality. The principal effect observed is enlargement of the liver.

Specific reproduction and developmental tests are not available for this chemical. However, adequate information on reproductive and developmental toxicity based on testing with structurally-related chemicals in the HPV program (CAS 2082-79-3, CAS 6683-19-8 and CAS 32687-78-8). This information demonstrates that hindered phenol compounds of this type do not pose significant risks of reproductive or developmental effects. In addition to the information on these structurally related chemicals, analysis of reproductive organs in the existing 90-day studies for Irganox 1035 demonstrates that

[1] Ciba has conducted a new water solubility study which indicates the solubility limit is ~5-7 ppb (this work is described in a revised robust summary on water solubility).

gonadal effects do not occur. A robust summary has been added describing these data.

EPA's comments on the initial submission indicated that the in vivo Nucleus Anomaly Test was inadequate and it was recommended that a new study comparable to OECD 473 be conducted. The cytogenic testing available for the hindered phenol compounds CAS 2082-79-3 and CAS 6683-19-8 has demonstrated that these compounds are not clastogenic. Additional supporting data relating to hindered phenol antioxidants has been presented for the HPV Hindered Phenol Category, sponsored by the American Chemistry Council. We believe the in vivo Nucleus Anomaly Test (see p. 34-35) submitted previously also provides relevant supporting evidence on the potential for Irganox 1035 to cause chromosomal damage despite the agency's criticism of this study. The foregoing data indicates a low concern for clastogenic effects and collectively fulfills the requirement.

This material is sold only to large industrial users as an ingredient for their products and processes. There are no direct consumer applications for this compound and no direct sales to the general public. Ciba's industrial hygiene programs and Responsible Care practices limit worker exposure and no adverse effects have been associated with manufacturing or use of the material.

Conclusions

Acceptable testing and read-across data are available to fulfill all HPV endpoints. These data do not raise significant concerns for adverse effects on man or the environment from the product as presently used.

SUMMARY TABLE

CAS No. 41484-35-9			
PHYSICAL/CHEMICAL ELEMENTS	**DATE**	**RESULTS**	**FULFILLS REQUIREMENT**
Melting Point	2001	63.0 – 68.0 °C	Yes
Boiling Point	2003	664.94 °C	Yes
Vapor Pressure	2003	7.5×10^{-18} mm Hg	Yes
Partition Coefficient	2003	log Kow > 10.36 (estimated)	Yes
Water Solubility	2006	~ 0.005 mg / liter (measured)	Yes
ENVIRONMENTAL FATE AND PATHWAYS ELEMENTS			
Photodegradation	2003	For reaction with hydroxyl radical, predicted rate constant = 60.98×10^{-12} cm^3/molecule-sec. Predicted half-life = 2.103 h.	Yes
Stability in Water / Hydrolysis	2003	EPIWIN model could not evaluate this structure. Experimental determination is not practical due to low water solubility.	NA
Fugacity	2003	Predicted distribution using Level III fugacity model Air 0.00046 % Water 1.04 % Soil 44.4 % Sediment 54.6 %	Yes
Biodegradation	1984	Not biodegradable 10 mg/L: 7% in 28 days 20 mg/L: 2% in 28 days	Yes
ECOTOXICITY ELEMENTS			
Acute Toxicity to Fish	1984	Zebra Fish : LC_{50} (96 h) > 57 mg/L	Yes
		Rainbow Trout: LC_{50} (96 h) > 61 mg/L	
Toxicity to Aquatic Plants	1993	EC_{50} (0-72 h) > 41 mg/L	Yes
Acute Toxicity to Aquatic Invertebrates	1984	i) EC_{50} (24 h) > 4.4 mg/L	Yes
	2002	ii) EC_{50} (24 h) > 100 mg/L	

SUMMARY TABLE (CONTINUED)

CAS No. 41484-35-9			
HEALTH ELEMENTS	**DATE**	**RESULTS**	**FULFILLS REQUIREMENT**
Acute Toxicity	1982	Rat: LD_{50} (Oral) > 5,000 mg/kg	Yes
	1975	Rabbit: LD_{50} (Dermal) > 3,000 mg/kg	
	1975	Rat: LD_{50} (Inhalation) > 6,300 mg/ m^3	
Genetic Toxicity			
In Vitro (Ames)	1984	Ames Test - Salmonella typhimurium: No increase in mutations with or without metabolic activation (at doses of 20, 80, 320, 1280 and 5120 µg/ 0.1 ml)	Yes
In Vivo (Nucleus Anomaly Test)	1984	No Nucleus anomalies found in Chinese hamster bone marrow cells following oral doses of 875, 1750 and 3500 mg/kg	Requirement met by Nucleus Anomaly Test testing and by testing for structurally-related hindered phenol antioxidants (CAS 2082-79-3 and CAS 6683-19-8)
Repeated Dose Toxicity *Subchronic Toxicity*			
i) 90-Day oral toxicity study in rats	1983	NOEL = 60 ppm	Yes
ii) 90-Day oral toxicity study in rats	1973	NOEL < 10000 ppm	
iii) 90-Day oral toxicity study in beagle dogs	1973	NOEL = 2000 ppm	
Reproductive Toxicity		No reproductive effects likely based on testing with structurally-related compounds. No significant effects on reproductive organs in subchronic tests with rats, mice and dogs.	Requirement met by testing for structurally-related hindered phenol antioxidants (CAS 2082-79-3, 6683-19-8 and 32687-78-8) and reproductive organ analysis in 3 sub-chronic toxicity studies with Irganox 1035.
Developmental Toxicity		No developmental effects likely based on testing with structurally-related compounds.	Requirement met by testing for structurally-related hindered phenol antioxidants (CAS 2082-79-3, 6683-19-8 and 32687-78-8)